Integrated planning of buildings based on computer models in project communication systems

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Summary

The increasing demands in building and civil engineering – with regard to the growing amount of legal requirements and the needs of a flexible usage of the building - requires an optimisation of all processes during the planning and construction phases. This aim can be only reached by transferring of innovative information and communication technologies in the field of cooperation of all partners in a building project. In this article the enhancement of the existing planning processes based on an improved information management is introduced.

Since the late 90ies the availability of hardware and software infrastructures for a network-based cooperation, e.g. email, in small and middle-sized companies increased the problems of an unstructured communication in the planning and construction processes. These problems have not been solved by the usage of the upcoming project communication systems either, which are often used as a simple medium for data transfer. Because of the easy way of distributing documents to all planning partners a huge amount of files and subsequent versions can be stored so that the planners often have to scope with an information overflow. The underlying hierarchical structures based on simple files stored in tree views are not sufficient for an adequate representation of the different specific views of the planners and the management of relationships between the three information domains building structure, costs and time schedules.

The research project “Baukom-Online”, sponsored by the German ministry for education and research, aims at the holistic integration of the processes of planning, design and construction based on computer models within an internet-based software system. Thus, in addition to the conventional document-based approaches of project communication systems the BauKom-Online platform provides different specific models which represent the three information domains.

Within this article the advantages of this model-based approach for the organization of information in building projects, especially in the fields of the geometrical and cost-based structures, are introduced. A three-dimensional building model has been created which can be used for graphical-interactive information filtering and retrieval. With regard to the demands of practical usage the creation and management of these models and the associated relationships have to be very easy. Thus, an integrated model manager based on the java technology has been developed which allows the planning partners to combine the various information in an internet browser easily, leading to a higher transparency in building and construction processes. The combination of usual, document-based approaches with model-driven structures allows the creation of semantic relationships between the information domains building structure, costs and time schedules. Therefore, the determination of influences which are caused by the decisions of the planning partners, becomes possible. The consistency of the available information for all planning partners can be improved efficiently and the information overflow can be avoided. This leads to an overall improvement of the quality of the planning and construction results and therefore to more efficient planning and construction phases.

1 Introduction

Since a few years project communication systems (pcs) have achieved an increasing importance in medium and big size building projects. They offer a common, internet-based platform for all planning partners for an effective cooperation and data exchange. In most cases they are used as medium for the storage and exchange of flat files so that the planning partners can access the underlying plans and text documents according to their given rights. Using attributes within this system the planning partners can search for specific documents in the central data pool.

With regard to an effective retrieval a planning partner has to know the pre-defined structure and the type of document which might contain the desired planning information. Furthermore, several systems use encoded file names which shall show the relationship e.g. to a specific floor of the building or a specified craft. The search of a planning partner in a data pool with a static structure which does not support the creation of views can become very time-consuming, especially if he is looking for all related information, e.g. plans, notices, protocols, calculations, of a given location. Furthermore, he must be aware of the fact that his search results might not be complete.

In the research project BauKom-Online (BauKom 2003) a view concept has been developed that allows an access to the underlying planning information using different ways without a redundant storage of documents in the system. This view concept enables a structuring of documents based on spatial relationships: A three-dimensional, model-based order in which semantic relationships between the documents and small units of the geometrical building model can be built up (Fig. 1). Furthermore, spatial relationships across the usual analysis of ground and section plans can be created.

The required 3D-models for this approach usually are only available in big-size projects. An exchange and a global provision of these models normally are not performed in most cases due to the lack of suitable interfaces. In addition, the effort for the generation and the actualisation is not rewarded financially in the planning process.

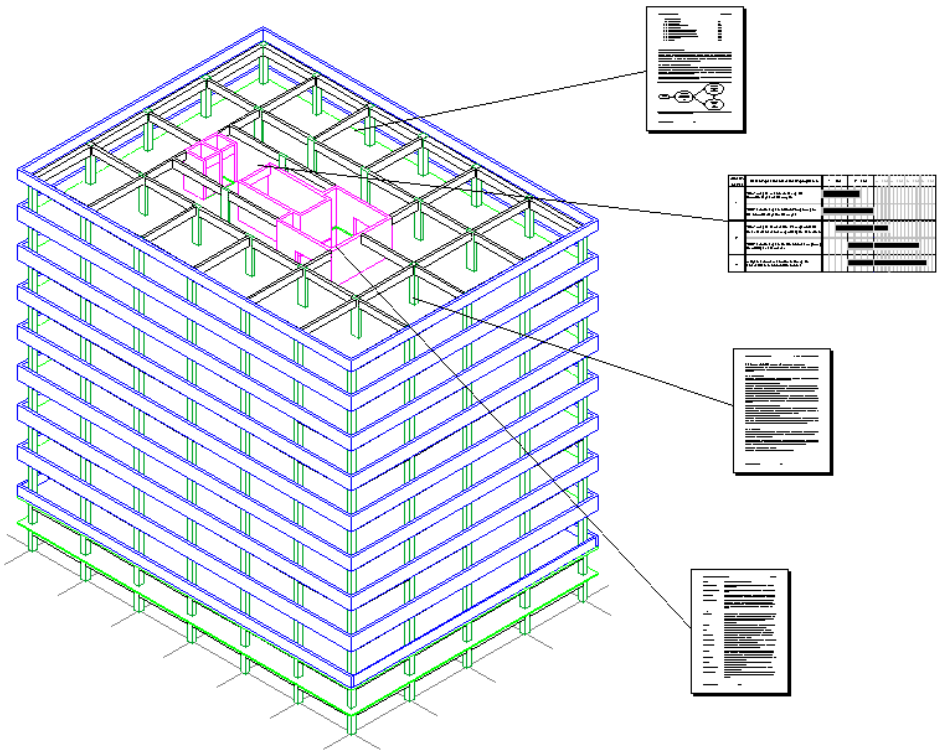

Fig. 1: Model-based structurization of planning information

2 The BauKom-Online Navigation Model

Within the BauKom-Online project a hybrid concept has been chosen, which combines the model-based approach and its advantages of semantic relationships with the practical way of dealing with two-dimensional plans. In this concept a combination of planning- and cost-related information with the building structure has been realized. The granularity of the building structure is of a major importance because it shall not be too detailed so that the planners can keep the overview easily. Otherwise it should not be too simple so that all partners can benefit from the advantages of the spatial order. Thus a partitioning of a building into room- and zone-based structures seems to be advantageous for all purposes (Díaz et al 2002).

The described approach comprises the elements site, building, floor, segment and room which are suitable for a reuse in subsequent processes for the facility management as well (Fig. 2).

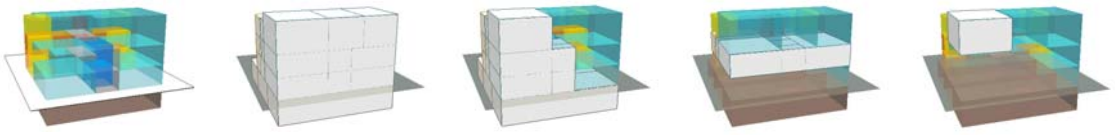

Fig. 2: The model elements site, building, segment, floor and room

Structural elements or parts of the heating and ventilation system have been left out intenionally because they do not exist in early planning phases and they reduce the acceptance for the majority of the system users. Furthermore, the independence of the model concerning crafts could not be guaranteed and the effort for the model generation and actualisation would increase dramatically.

The described navigation model enables the following use cases:

- Visualisation of the building structure
- Selection of building parts
- Provision and visualisation of semantic information
- Logical interconnection of documents
- Graphical retrieval of related semantic information

3 Implementation of the 3D Navigation Model

Based on the Java 3D-Technology an integrated component in the BauKom-Online framework has been developed which enables an interactive browsing in the 3D navigation model (Fig. 3). Furthermore it provides direct acces to the results of a graphical retrieval and its related semantic information (Fig. 4).

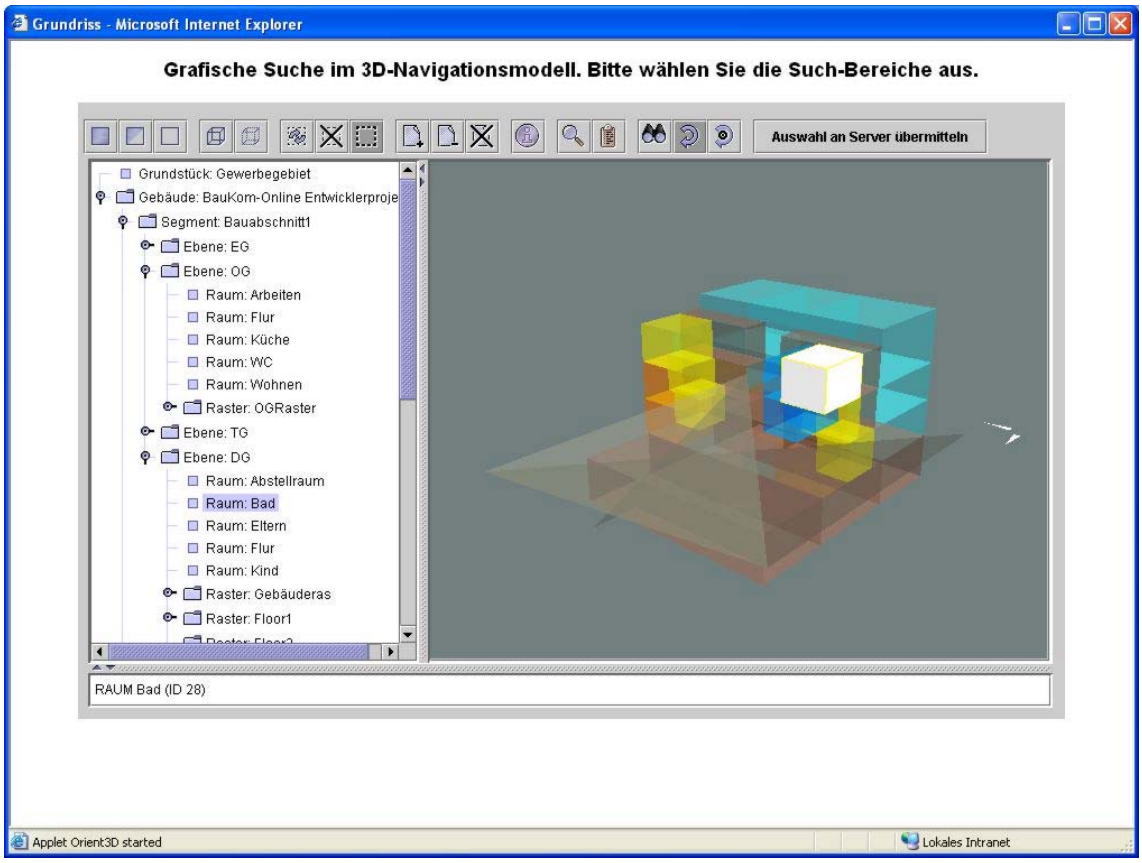

Fig. 3: The browser component for the navigation model

Fig. 4: Various results of a graphical retrieval

4 Integrative modeling of cost information in the project communication system BauKom-Online

Based on the introduced method for the structurisation based on a 3D navigation model an integration of crafts and costs has been implemented.

During the tender phase a variety of software systems and methods are used by the planning partners which complicates the communication between bidder and promoter. With regard to the integration in the Baukom-Online system the German GAEB standard has been adopted because this interface is supported by many calculation programs (Díaz 2001) (GAEB 2002). After the import of specifications and schedules of prices (currently the GAEB phases D83-89 are supported) an interactive assignment with the elements of the integrated building model can take place. (Fig. 5). The BauKom-Online cost componente allows a generation of various cost views:

- Structurisation according to the specifications
- Structurisation according to the crafts
- Structurisation according to the DIN 276 standard
- Structurisation according to the building structure
- User-defined structurisation as a result of an interactive retrieval

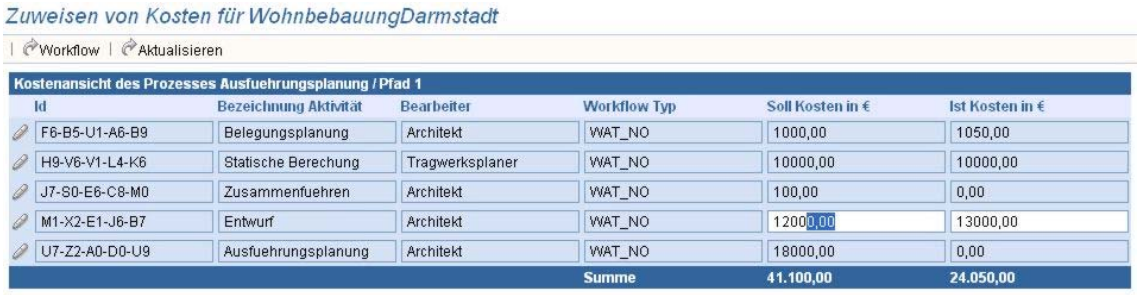

Fig. 5: Assignment of cost information in BauKom-Online

5 Integration of construction processes using mobile computing

The upcoming information and communication technologies enable new possibilities for the integration of all processes on the construction site. Using methods of mobile computing the usage of information technology ist not restricted to static computer workstations any more. Thus within the BauKom-Online Project a mobile frontend has been developed in order to manage the workflows, to create protocols for the calculation and organize the quality management (Fig. 6).

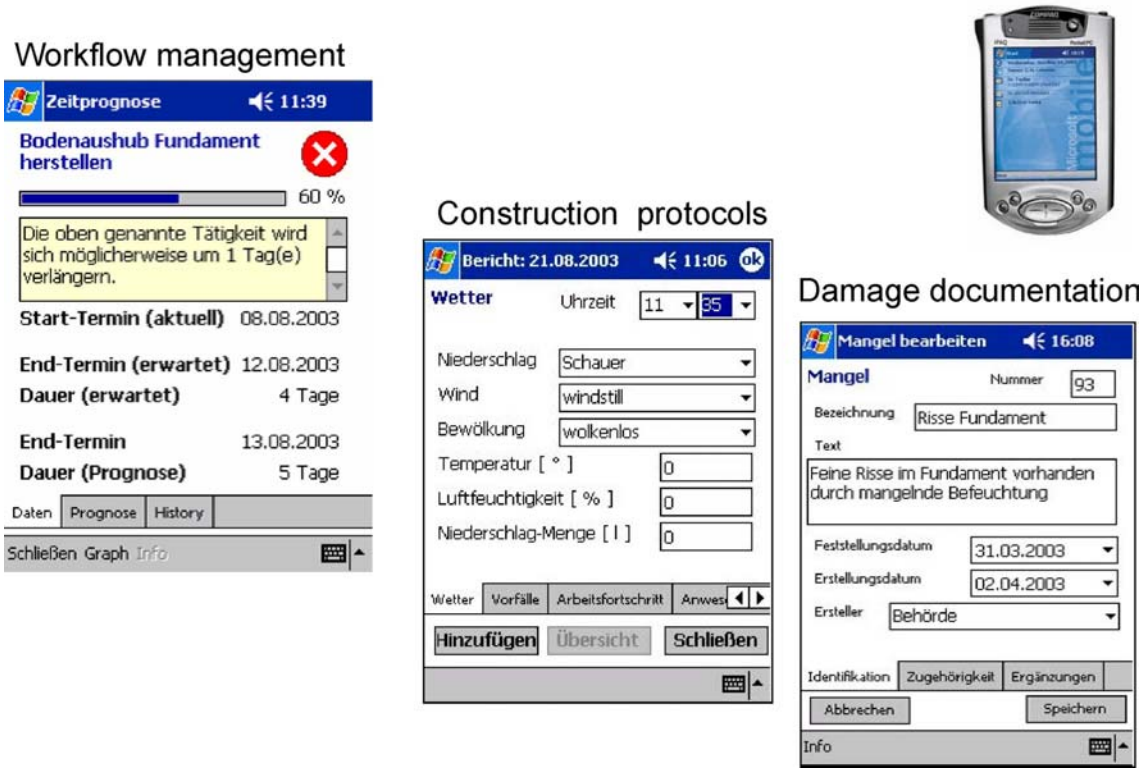

Fig 6: Use cases for the BauKom-Online Mobile Component

6 Endnotes

In this paper an integration of various specific views in the planning and construction process based on project communication systems is introduced. It allows (in combination with the concepts for the workflow management presented in another contribution - Internet-based Workflow-Management for Civil Engineering Projects by Uwe Rüppel and Thomas Klauer) a holistic management of all processes in building and civil engineering.

Further steps are necessary in order to transfer the results of this project into a joint use. The described platform allows a new form of cooperation between the planning partners which can result in a higher quality and a better understanding in building projects and thus to a better efficiency in the upcoming global markets.

7 References

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